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(54) METHOD FOR STRAIGHTENING

BEGRADIGUNGSVERFAHREN

PROCÉDÉ DE DRESSAGE

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Description

TECHNICAL FIELD

[0001] The present invention relates to a method for straightening a steel pipe or bar. More particularly, the present invention relates to a method for straightening, in which the wear of a roll of a straightening machine is suppressed, concavity and convexity of roll surface caused by the wear are prevented from being transferred to the steel product, and time for changeover and/or setup of rolls can be shortened to improve the efficiency of a finishing process.

[0002] Unless otherwise described, definitions of terms in this description are as follows:

"Hard alloy straightening roll": a straightening roll made of a tungsten carbide-cobalt (WC-Co) based sintered material (hard alloy). Also referred simply to as a "hard alloy roll".

"Hardness": The hardness of a roll or a product to be straightened is represented by Rockwell hardness (scale A) measured by the Rockwell hardness test specified in JIS Z 2245, and is expressed, for example, as "HRA86".

BACKGROUND ART

[0004] A steel product such as a pipe or bar is produced through a hot or cold working process, and bends of the steel product are generated during such processing stages and/or during heat treatment that is carried out midway through such processing stages. These bends are straightened, in a finishing process, usually by using a straightening machine that uses specific rolls, such as a cross roll type straightening machine (straightener) in which a plurality of concave globoidal drum type rolls are arranged.

[0005] However, especially when the bends of a high-strength product such as a steel pipe for a motor vehicle air bag are straightened, the roll happens to wear (partial uneven wear), and therefore the roll shape deviates easily from the design roll profile. In some cases, minute concavity and convexity generated by the wear may cause a spiral defective mark on the product being straightened, or the concavity and convexity may be transferred to the product being straightened. In addition, the setting of roll position (setup) at the time of straightening, which is called crush and offset, must be changed, so that the operation rate of the straightening machine is decreased due to the extended time of changeover and/or setup of rolls. As a result, the efficiency of a finishing process and, in turn, the productivity decrease, and the straightening accuracy is reduced.

[0006] As a pipe straightening method, for example, Patent Literature 1 discloses a method in which, to prevent stress corrosion cracking in a product on account of residual stress occurring at the time of straightening, a pipe is straightened while an amount of crush required in pipe straightening is controlled in such a manner that the occurrence of excessive residual stress is avoided. However, Patent Literature 1 does not describe the suppression of roll wear, so that the method described in this Literature cannot be a solution for the above-described problems.

[0007] Also, Patent Literature 2 discloses a method for straightening bends of a steel pipe, in which the bends are removed by moving the steel pipe forward while an enforced deflection is given to the steel pipe by sets of offset rolls, wherein the direction of offset for all sets of offset rolls can be reversed every time when a predetermined number of pipes are straightened. By using this method, the wear of upper rolls and lower rolls can be uniformized, and the rearrangement work of the upper and lower rolls can be eliminated. However, the wear itself cannot be reduced.

[0008] A method and a device for manufacturing a tube are described in JP 2005/103557, wherein straightening rolls alternately press the side of the curved center side. In JP 2004/136296, a composite rolling roll is described.

CITATION LIST

PATENT LITERATURE

[0009]

Patent Literature 1: Japanese Patent Application Publication No. 55-128318

Patent Literature 2: Japanese Patent Application Publication No. 8-47722

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0010] As describe above, when bends generated in a steel product such as a pipe or bar are straightened, especially when bends of a high-strength product such as a steel pipe for a motor vehicle air bag are straightened, the roll wear inevitably occurs, so that defective roll mark(s) may be formed on the surface of a product being straightened due to the

roll wear, or time for changeover and/or setup of rolls may take long time. It is difficult to overcome these problems by using the prior art techniques.

[0011] The present invention has been made to solve such problems, and accordingly an objective thereof is to provide a method for straightening, in which when bends of a steel pipe or bar, especially when bends of a high-strength product such as a steel pipe for a motor vehicle air bag, are straightened by means of a straightening machine using rolls such as a straightener, roll wear is suppressed, the concavity and convexity of roll surface caused by the roll wear are prevented from being transferred to a product being straightened and a defective roll mark(s) is prevented from being formed, and time for changeover and/or setup of rolls can be reduced to improve the efficiency in a finishing process and, in turn, the productivity.

SOLUTION TO PROBLEM

[0012] The problem above is solved according to the present invention by a method according to claim 1. Dependent claims 2 to 7 define preferred embodiment of the method of the invention. An use of hard alloy straightening rolls is defined in claim 8.

[0013] The "method for straightening in which rolls are used" as used herein is a straightening method using a roll-type straightening machine that includes upper and lower rolls as being arranged above and below the product to be straightened and that is used to straighten bends while the product to be straightened is moved forward, and is usually a straightening method using a cross roll type straightening machine (straightener). Also, the "steel product" is a pipe or bar the bends of which can be straightened by this method for straightening regardless of material grade.

ADVANTAGEOUS EFFECTS OF INVENTION

[0014] The method for straightening in accordance with the present invention is a straightening method using hard alloy straightening rolls each having a hardness of HRA85 to 87. According to this method, when bends of a pipe or bar are straightened by using rolls of a straightener or the like, roll wear is suppressed, a defective roll mark(s) attributable to the roll wear is prevented from being formed on the surface of a product being straightened, and time for changeover and/or setup of rolls is shortened to enhance the operation rate of the straightening machine, whereby the efficiency of a finishing process and, in turn, the productivity can be improved.

BRIEF DESCRIPTION OF DRAWINGS

[0015]

[FIG. 1] FIG. 1 is an explanatory view for a method for evaluating the wear resistance of a starting material for a roll.

[FIG. 2] FIG. 2 is a diagram showing the examination result of wear resistance of a starting material for a roll.

[FIG. 3] FIG. 3 is a schematic view showing the outline configuration of a straightener used for the straightening of a steel pipe and the location in which hard alloy rolls are used.

[FIG. 4] FIG. 4 is a diagram showing the examination result of an amount of wear of a roll in a case where the method for straightening in accordance with the present invention is applied, comparing with the case where conventional rolls are used.

[FIG. 5] FIG. 5 is a diagram showing the examination result of the surface roughness of a roll in a case where the method for straightening in accordance with the present invention is applied.

[FIG. 6] FIG. 6 is a diagram showing a required time for changeover and/or setup of rolls in a case where a steel pipe for an air bag is straightened by applying the method for straightening in accordance with the present invention, comparing with the case where conventional rolls are used.

[FIG. 7] FIG. 7 is a diagram showing operation rates of a straightener in a case where steel pipes for an air bag are straightened by applying the method for straightening in accordance with the present invention, comparing with the case where conventional rolls are used.

DESCRIPTION OF EMBODIMENT

[0016] To solve the above-described problems, the present inventors made an attempt to suppress roll wear by optimizing the material grade of roll, and tried to use a WC-Co based sintered material as a material grade of roll. The WC-Co based sintered material is a composite material in which Co is added as a binder to the fine powder of WC to form a sintered material, and is called hard alloy. Because of having high hardness and excellent wear resistance, the WC-Co based sintered material is frequently used as a starting material especially for a cutting tool.

[0017] The wear resistance and heat crack resistance of this hard alloy were examined. As a result, the present

inventors have confirmed that the hard alloy has wear resistance that is about 100 times that of a tool steel (SKD1: 2.1C-12Cr specified in JIS G 4404, hereinafter, referred simply to as "SKD") having been used conventionally as a starting material for a roll. Also, it has been found that the hard alloy has heat crack resistance (evaluated by the number of repetitions before crack generation as a result of repetition of heating-water cooling) sufficiently applicable for a roll as a starting material.

[0018] Further, as a result of using the hard alloy roll as a straightener roll on an actual machine, it could be verified that no wear was found, and also the time for changeover and/or setup of rolls was reduced, so that the operation rate of straightener can be improved.

[0019] The present invention has been made based on the above-described findings, and as described above, provides a method for straightening a steel pipe or bar the method comprising using hard alloy straightening rolls, wherein the hardness of each rolls is HRA85 to 87.

[0020] The reason why using the hard alloy straightening rolls are prerequisite for the present invention is that the hard alloy, which is a composite material of ceramics and metals, is hard and excellent in wear resistance, and also has heat crack resistance, so that the hard alloy is suitable as a starting material for a roll. That is, hardness, wear resistance, and heat resistance (withstanding heat generation at the time of straightening using rolls) are necessary for the material of straightener roll, and the hard alloy is excellent in all of such properties.

[0021] The reason why the hardness of the straightening roll is controlled to be in the range of HRA85 to 87 in the present invention is that both of the wear resistance and heat resistance can be high owing to the controlled hardness. If the roll hardness is less than HRA85, the difference in hardness between the product to be straightened and the rolls becomes small, and the wear resistance becomes insufficient. Above the roll hardness of HRA87, although the wear resistance increases, the heat resistance decreases, and the tendency of degradation of the heat crack resistance appears.

[0022] The method for straightening in accordance with the present invention is especially effective in the case where a product to be straightened is a steel pipe for a motor vehicle air bag.

[0023] The steel pipe for a motor vehicle air bag is made of a high-strength steel having tensile strength of approximately 800 to 1100 MPa. In the case where the tensile strength is 1100 MPa, the corresponding hardness is about HRA68.5. When the bends of such a steel pipe for the air bag having high strength and high hardness are straightened, if rolls each made of an ordinary tool steel (SKD, for example, SKD11: 1.5C-12Cr-1.0Mo, etc.) are used, roll wear is liable to occur, and defective roll mark(s) is formed on the surface of the product being straightened. Also, with the development of the wear (with the increase in amount of decrease caused by the wear), time required for changeover and/or setup of rolls becomes longer, and the operation rate of the straightening machine such as the straightener decreases, hence it often happens that the efficiency of a finishing process decreases.

[0024] In such a case, if the method for straightening in accordance with the present invention, the method comprising using the hard alloy straightening rolls, is applied, as described in the after-described Examples, the roll wear is substantially perfectly suppressed, the surface roughness does not exhibit any significant change (that is, the formation of defective roll mark(s) is not discernible), and time for changeover and/or setup of rolls is shortened.

EXAMPLES

(Example 1)

[0025] For the hard alloy, which is a starting material for the hard alloy roll used in the method for straightening in accordance with the present invention, the wear resistance and heat crack resistance thereof were examined. For the wear resistance, for comparison, the same examination was performed on the tool steel SKD (used after being subjected to sub-zero treatment), which is the conventional starting material for a roll.

[0026] Table 1 shows material grades and characteristics of test specimens. In Table 1, the "grain size" is the grain size in hard alloy.

[0027] As given in Table 1, hard alloys A, B and C are materials in which amounts of addition of Co to WC are about 15%, 16% and 17% (all: mass-percent), respectively. With the increase in addition amount of Co, the hardness varies from HRA88.0 to HRA85.0.

[Table 1]

[0028]

Table 1

Material grade	Hardness (HRA)	Grain size (μm)	Composition
Tool steel: SKD	82-85	-	2.1C-12Cr
Hard alloy A	88.0	1-2	WC-15Co
Hard alloy B	86.5	2-4	WC-17Co
Hard alloy C	85.0	2-4	WC-18Co

[0029] FIG. 1 is an explanatory view for a method for evaluating the wear resistance of a starting material for a roll.

[0030] As shown in FIG. 1, a ball 1 (material grade: SUJ, diameter: 15 mm) that is loaded was forced to repeatedly slide on a test specimen 2, and an amount of wear (wear volume) of the test specimen 2 by the test was measured. This amount of wear was converted into a specific wear amount (wear volume per unit slide distance and unit load $[\text{mm}^3/(\text{MM}\cdot\text{N})] = [\text{mm}^2/\text{N}]$), and the wear resistance was evaluated by comparing the specific wear amount with that of the tool steel SKD (the conventional roll material).

[0031] FIG. 2 is a diagram showing the examination result of wear resistance. As shown in FIG. 2, the specific wear amount of any of hard alloys A, B and C was remarkably small, being one-hundredth or less of the case of the tool steel SKD. It is convinced that any of hard alloys has wear resistance of about 100 times that of the conventional roll material. Also, in comparison among hard alloys A, B and C, for the hardest hard alloy A having a hardness of HRA88.0, the specific wear amount was small, so that the wear resistance was the most excellent.

[0032] The heat crack resistance of the hard alloy was evaluated as described below. A test specimen was subjected to a repetition test process of "heating (700°C)" $\rightarrow$ "water cooling", and evaluation was done by the number of repetitions before cracking is generated on the test specimen. The larger the number of repetitions is, the more excellent the heat crack resistance is.

[0033] Table 2 gives the evaluation result of heat crack resistance. In Table 2, mark $\bigcirc$ indicates that the generation of cracking was not discerned, and mark $\times$ indicates that cracking was generated. The presence or absence of crack generation was judged by visual observation.

[Table 2]

[0034]

Table 2

Material grade	Number of repetitions of heating-water cooling			
	1	5	10	20
Hard alloy A	$\bigcirc$	$\bigcirc$	$\times$	$\times$
Hard alloy B	$\bigcirc$	$\bigcirc$	$\bigcirc$	$\bigcirc$
Hard alloy C	$\bigcirc$	$\bigcirc$	$\bigcirc$	$\bigcirc$

[0035] As shown in Table 2, for hard alloys B and C, even if the number of repetitions of heating-water cooling was 20, the generation of cracking was not discerned: in contrast, for hard alloy A, after 10 times of repetitions, cracking was generated.

[0036] Table 3 gives the result of comprehensive evaluation of wear resistance, heat crack resistance, and hardness for hard alloys A, B and C. Since any of hard alloys exhibited a good wear resistance, all of them were to be rated as " $\bigcirc$ " (good). In particular, the case where the specific wear resistance was less than $100 \times 10^{-12} \text{ mm}^2/\text{N}$ (hard alloy A) was rated to be " $\odot$ " (superior) (refer to FIG. 2).

[0037] For the heat crack resistance, as the performance after 10-times-repetitions of heating-water cooling is set to a reference, the case where the generation of cracking was not recognized after 10-times repetitions was rated to be " $\bigcirc$ " (good), and the case where no problem occurred at 5-times repetitions but cracking was generated after 10-times repetitions was rated to be " Δ " (fair). Also, for the hardness of hard alloy, since any of the hard alloys had a sufficient hardness, all of the cases were to be rated as " $\bigcirc$ ". In particular, the case where the hardness was HRA88.0 or more (hard alloy A) was rated to be " $\odot$ " (superior).

[Table 3]

[0038]

Table 3

Material grade	Wear resistance	Heat crack resistance	Hardness	Comprehensive evaluation
Hard alloy A	◎	Δ	◎	Δ
Hard alloy B	○	○	○	○
Hard alloy C	○	○	○	○

[0039] As shown in Table 3, hard alloy A (hardness: HRA88.0) was the hardest among the alloys subjected to examination and had excellent wear resistance, but had poorer heat crack resistance than those of hard alloys B and C, so that, in the comprehensive evaluation, hard alloy A was rated to be "Δ" (fair) (the heat crack resistance was relatively poor). In contrast, hard alloys B (hardness: HRA86.5) and C (hardness: HRA85.0) were good in wear resistance and heat crack resistance, so that, in the comprehensive evaluation, hard alloys B and C were rated to be "○" (good).

[0040] From the above-described examination results, it is convinced that the hard alloys that are used as a starting material for the hard alloy roll to be used in the method for straightening in accordance with the present invention are very high in wear resistance, and the hardness of hard alloy is preferably controlled within the range of HRA85 to 87.

(Example 2)

[0041] The method for straightening in accordance with the present invention was applied for the straightening of a steel pipe using a straightener to examine an amount of wear and the surface roughness of the roll and to check how much a required time for changeover and/or setup of rolls was shortened at the time that a steel pipe for a motor vehicle air bag was straightened. For comparison, the same examination was performed for the case where the conventional rolls (material grade: tool steel SKD11) were used.

[0042] Table 4 summarizedly gives the characteristics of the straightener roll material grades used in the examinations. The material grade of the hard alloy roll used in the method for straightening in accordance with the present invention is hard alloy B used in Example 1.

[Table 4]

[0043]

Table 4

Roll material grade	Hardness (HRA)	Grain size (μm)	Composition	Specific wear amount (mm ² /N)
Tool steel: SKD11	82-85	-	1.5C-12Cr-1.0Mo	11310
Hard alloy B	86.5	2-4	WC-17Co	105

[0044] FIG. 3 is a schematic view showing an outline configuration of a straightener used for the straightening of a steel pipe for an air bag and the positions at which the hard alloy rolls were arranged. The straightener was of a 2-2-2-1 type. For upper and lower rolls at Positions #2 and #3, which generally exhibit heavier wear, hard alloy rolls were applied (in FIG. 3, relevant rolls are indicated by hatched line), and for Position #1 rolls as being guide rolls and the final Position #4 roll, conventional SKD11-made rolls were used. The dimensions of roll were 190 mm in roll mid-length (minimum) diameter and 180 mm in roll width.

[0045] A steel pipe to be straightened was a pipe having an outside diameter of 15.90 to 42.7 mm.

[0046] Table 5 summarizedly gives the rolls on which an amount of wear and the surface roughness were measured, the measurement locations, and the measurement methods.

[Table 5]

[0047]

Table 5

	Amount of wear	Surface roughness
5 Target roll for measurement	Position #2 lower roll (roll to which highest load is applied by offset)	
Measurement location	Mid-length (minimum diameter) portion of roll	
10 Measurement method	Measured with vernier calipers	Resin impression of roll surface is formed, and concavity and convexity (roughness) transferred to resin impression is measured with stylus-type surface roughness measuring instrument.

[0048] FIG. 4 is a diagram showing the examination result of an amount of wear of a roll at a time when the method for straightening in accordance with the present invention is applied, comparing with the case where the conventional rolls are used. The vertical axis of FIG. 4 represents wear rate (mm/km) obtained by dividing the amount of wear (amount of decrease in diameter caused by wear: mm) by the cumulative length (km) subjected to straightening.

[0049] As shown in FIG. 4, in the case where a tool steel SKD11-made roll was used, the wear rate at the time that the roll was used up until the conventional roll life expires (usage limit defined by wear: 2500 km in cumulative straightening length) was 1.6×10^{-3} mm/km. In contrast, it is verified that in the case where the method for straightening in accordance with the present invention, the method comprising using the hard alloy rolls, is applied, even after the cumulative straightening length had reached 4300 km (1.7 times the conventional roll life), the wear rate was 0 mm/km, and wear was not discerned at all.

[0050] FIG. 5 is a diagram showing the examination result of the surface roughness of a roll at the time that the method for straightening in accordance with the present invention is applied. The surface roughness is represented by maximum height (Rz).

[0051] As shown in FIG. 5, immediately after the straightening, minute concavity and convexity on the roll surface were smoothed, so that the surface roughness was improved (Rz became smaller), and thereafter, the surface roughness did not exhibit any significant change, being within the range indicated by solid doubleheaded arrow in the figure. Even after the cumulative straightening length had become more than 4300 km, the surface roughness did not change significantly.

[0052] FIG. 6 is a diagram showing the required time for changeover and/or setup of rolls at a time when a steel pipe for an air bag (outside diameter: 25 mm) is straightened by applying the method for straightening in accordance with the present invention, comparing with the case where the conventional rolls are used.

[0053] As is apparent from FIG. 6, in the case where the conventional rolls (made of tool steel SKD11) were used, as the cumulative straightening length became larger and the wear of roll increased, the time for changeover and/or setup of rolls was extended, being more than the target (within 30 minutes per one change) (indicated by the bold arrow in the figure). In contrast, in the case where the method for straightening in accordance with the present invention was applied, the method comprising using hard alloy rolls, wear did not occur, so that the extension of time for changeover and/or setup of rolls was not necessary, and this was completed within the target time.

[0054] FIG. 7 is a diagram showing operation rates of a straightener at a time when steel pipes for an air bag (outside diameter: 20 mm, 25 mm or 30 mm) are straightened by applying the method for straightening in accordance with the present invention, comparing with the case where the conventional rolls are used.

[0055] As is apparent from FIG. 7, regardless of the outside diameter of the steel pipe for an air bag to be straightened, the operation rate of the straightener was improved. The reason for this is that the time for changeover and/or setup of rolls was shortened by the application of the method for straightening in accordance with the present invention. Because the efficiency of the finishing process depends greatly on the operation rate of the straightener, the operation efficiency of the finishing process was improved by the improvement in operation rate of straightener.

[0056] From the above-described examination results, it could be verified that by the application of the method for straightening in accordance with the present invention, roll wear can be suppressed completely, the method for straightening in accordance with the present invention is made best suitable especially for straightening a steel pipe for an air bag, and the setup change time can be reduced to improve the working ratio of straightener.

INDUSTRIAL APPLICABILITY

[0057] The method for straightening in accordance with the present invention can be used effectively for straightening a bend occurring on a pipe or bar, especially for straightening a bend of a high-strength product such as a steel pipe for

a motor vehicle air bag.

REFERENCE SIGNS LIST

5 [0058]

- 1: ball
- 2: test specimen

10

Claims

1. A method for straightening a steel pipe or bar, in which hard alloy straightening rolls are used, **characterized in that** the hardness of each hard alloy straightening roll is HRA85 to 87.
2. The method for straightening according to claim 1, **characterized in that** the steel pipe to be straightened is a steel pipe for a motor vehicle air bag.
3. The method for straightening according to any of the preceding claims, wherein the hard alloy straightening rolls are made of a tungsten carbide-cobalt based sintered material.
4. The method for straightening according to any of the preceding claims, wherein a roll-type straightening machine comprising upper and lower rolls as the straightening rolls is used to straighten bends while the steel product to be straightened is moved forward, the upper and lower rolls being arranged above and below the product to be straightened.
5. The method for straightening according to claim 4, wherein a cross roll type straightening machine is used.
6. The method for straightening according to any of the preceding claims, wherein the steel pipe to be straightened has an outside diameter of 15.90 to 42.7 mm.
7. The method for straightening according to any of the preceding claims, wherein the straightening machine is a straightener of 2-2-2-1 type.
8. Use of hard alloy straightening rolls in the method for straightening according to any of the preceding claims, the hardness of each hard alloy straightening roll being HRA85 to 87, wherein the hard alloy is used for improving wear resistance and heat crack resistance of the straightening rolls.

Patentansprüche

1. Verfahren zum Richten eines Stahlrohrs oder einer Stange, bei dem Richtwalzen aus einer Hartlegierung verwendet werden, **dadurch gekennzeichnet, dass** die Härte jeder Richtwalze aus einer Hartlegierung HRA85 bis 87 beträgt.
2. Verfahren zum Richten nach Anspruch 1, **dadurch gekennzeichnet, dass** das zu richtende Stahlrohr ein Stahlrohr für einen Airbag für ein Kraftfahrzeug ist.
3. Verfahren zum Richten nach einem der vorhergehenden Ansprüche, wobei die Richtwalzen aus einer Hartlegierung aus einem Sinterwerkstoff auf Wolframcarbid-Kobalt-Basis hergestellt sind.
4. Verfahren zum Richten nach einem der vorhergehenden Ansprüche, wobei eine Rollenrichtmaschine, umfassend obere und untere Rollen als Richtwalzen verwendet werden, um Biegungen zu richten, während das zu richtende Stahlprodukt vorwärts bewegt wird, wobei die oberen und unteren Rollen über und unter dem zu richtenden Produkt angeordnet sind.
5. Verfahren zum Richten nach Anspruch 4, wobei eine Schrägrollenrichtmaschine verwendet wird.
6. Verfahren zum Richten nach einem der vorhergehenden Ansprüche, wobei das zu richtende Stahlrohr einen Au-

ßendurchmesser von 15,90 bis 42,7 mm hat.

7. Verfahren zum Richten nach einem der vorhergehenden Ansprüche, wobei die Richtmaschine eine Richtmaschine des Typs 2-2-2-1 ist.
8. Verwendung von Richtwalzen aus einer Hartlegierung in dem Verfahren zum Richten nach einem der vorhergehenden Ansprüche, wobei die Härte jeder Richtwalze aus einer Hartlegierung HRA85 bis 87 ist, wobei die Hartlegierung zur Verbesserung der Verschleissfestigkeit und der Wärmerissbeständigkeit der Richtwalzen verwendet wird.

Revendications

1. Procédé de dressage d'un tuyau ou d'une barre d'acier, dans lequel on utilise des galets de dressage en alliage dur et **caractérisé en ce que** la dureté de chaque galet de dressage en alliage dur est de HRA85 à 87.
2. Procédé de dressage selon la revendication 1, **caractérisé en ce que** le tuyau d'acier à dresser est un tuyau d'acier pour un coussin gonflable de sécurité automobile.
3. Procédé de dressage selon l'une quelconque des revendications précédentes, dans lequel les galets de dressage en alliage dur sont constitués d'un matériau fritté à base de carbure de tungstène et de cobalt.
4. Procédé de dressage selon l'une quelconque des revendications précédentes, dans lequel on utilise une machine à dresser du type à galets comprenant des galets supérieurs et inférieurs servant de galets de dressage pour dresser des coudes pendant que l'on fait avancer le produit d'acier à dresser, les galets supérieurs et inférieurs étant agencés au-dessus et en dessous du produit à dresser.
5. Procédé de dressage selon la revendication 4, dans lequel on utilise une machine à dresser du type à galets transversaux.
6. Procédé de dressage selon l'une quelconque des revendications précédentes, dans lequel le tuyau d'acier à dresser a un diamètre extérieur de 15,90 à 42,7 mm.
7. Procédé de dressage selon l'une quelconque des revendications précédentes, dans lequel la machine à dresser est une dresseuse de type 2-2-2-1.
8. Utilisation de galets de dressage en alliage dur dans le procédé de dressage selon l'une quelconque des revendications précédentes, la dureté de chaque galet de dressage en alliage dur étant de HRA85 à 87, dans laquelle on utilise l'alliage dur pour améliorer la résistance à l'usure et la résistance à la fissuration à chaud des galets de dressage.

FIG. 1

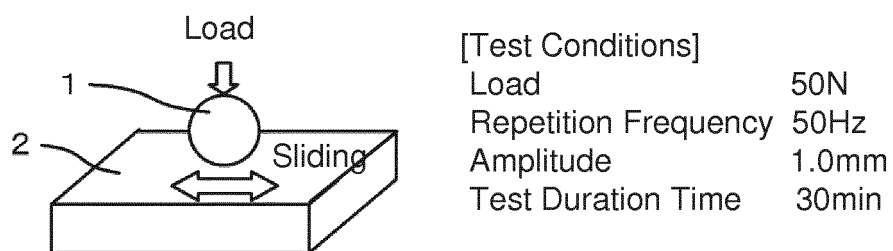


FIG. 2

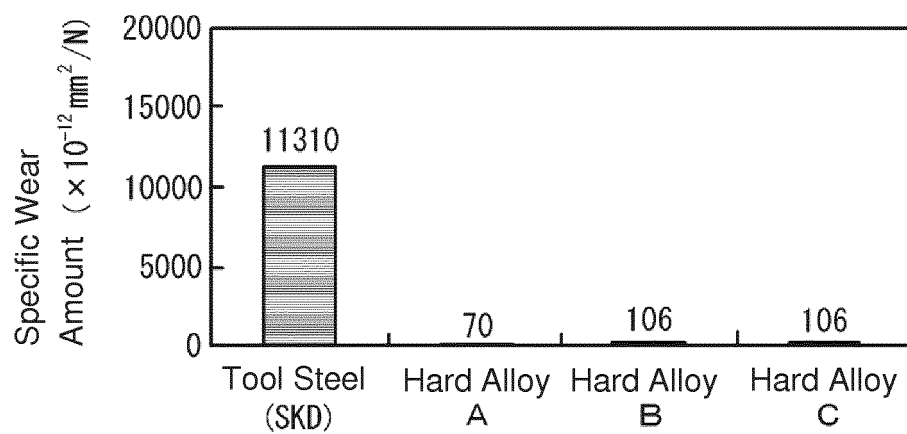


FIG. 3

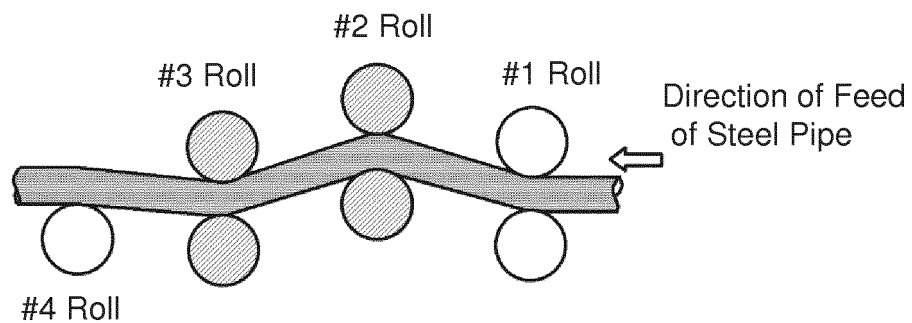


FIG. 4

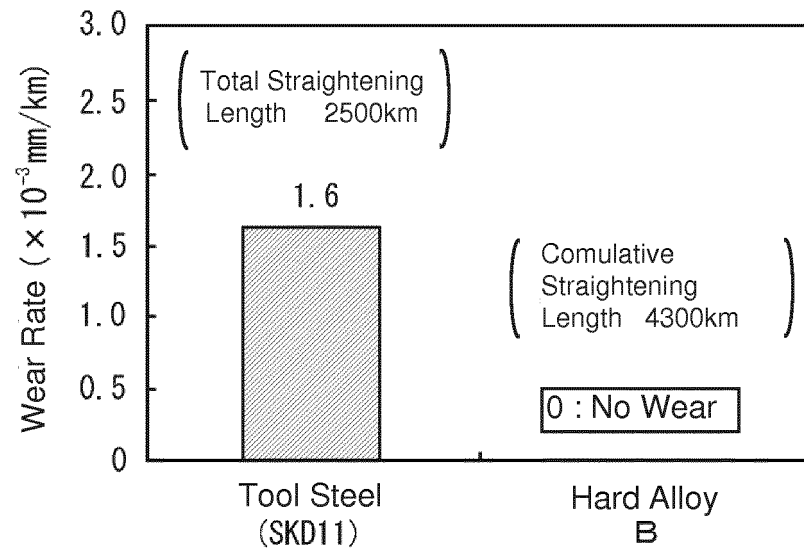


FIG. 5

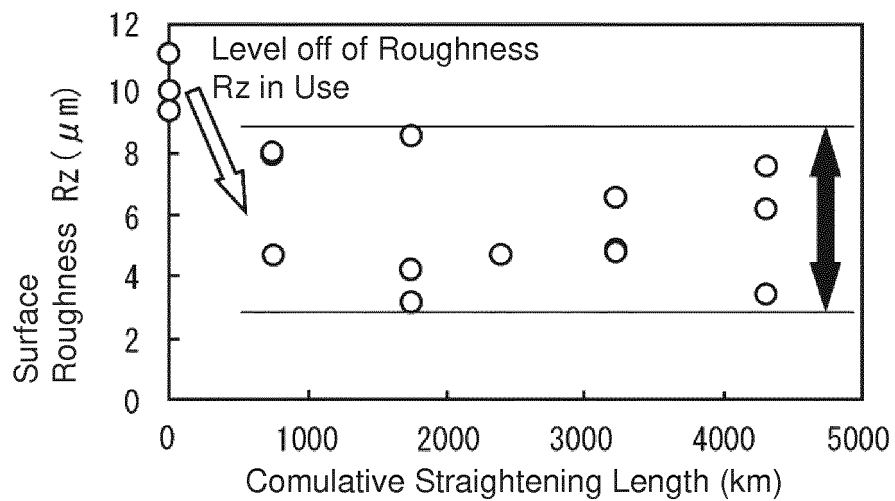


FIG. 6

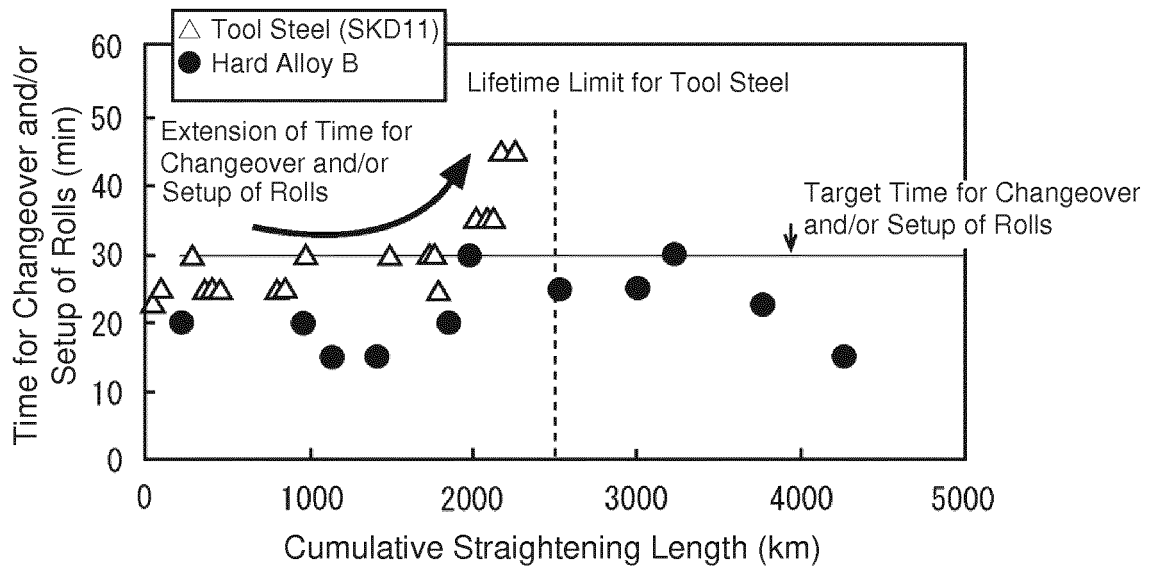
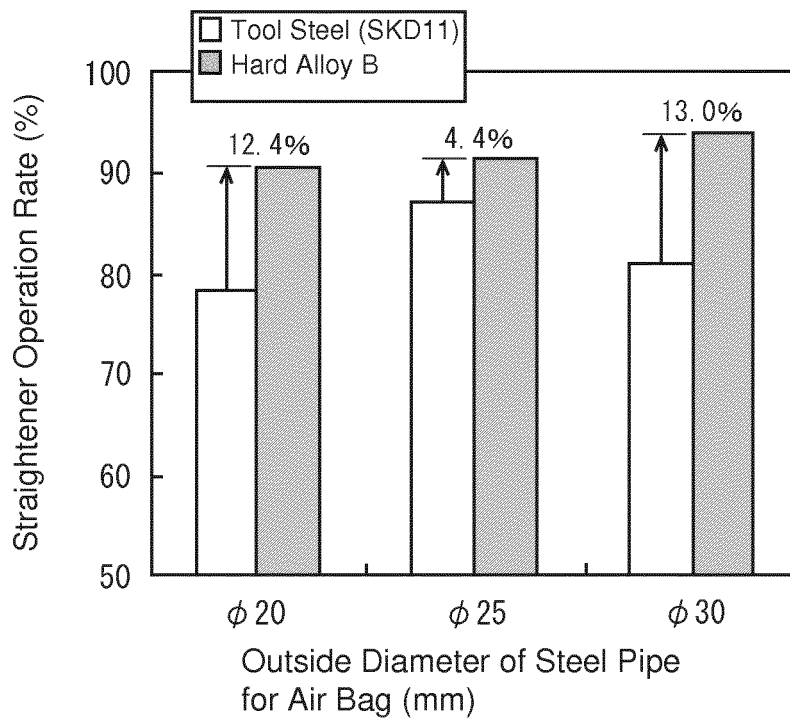


FIG. 7



REFERENCES CITED IN THE DESCRIPTION

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